AIR FORCE
QUALIFICATION TRAINING PACKAGE (AFQTP)

for

LIQUID FUEL SYSTEMS MAINTENANCE

(3E4X2)

MODULE 14

FUEL SYSTEMS

TABLE OF CONTENTS

MODULE 14

FUEL SYSTEMS

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

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INTRODUCTION

Before starting this AFQTP, refer to and read the "Trainee/Trainer Guide" located on the AFCESA Web site **http://www.afcesa.af.mil/**

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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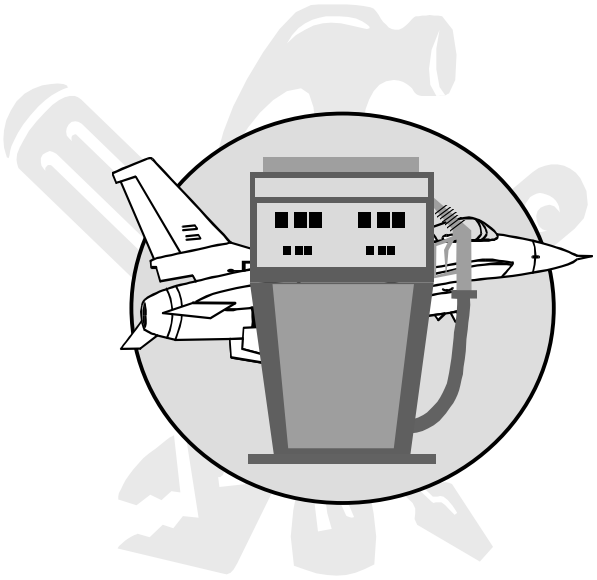

FUEL SYSTEMS

MODULE 14 **AFQTP UNIT 2**

INTERPRET MECHANICAL DRAWINGS (14.2.)

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INTERPRET MECHANICAL DRAWINGS

Task Training Guide

STS Reference Number/Title:	14.2. Interpret Mechanical Drawings
Training References:	• Tri-Service Standard, A/E/C CADD Standards • American National Standard Institute
Prerequisites:	• Possess as a minimum a, 3E432 AFSC.
Equipment/Tools Required:	• Architect's/Engineer's Scale • Mechanical Project Drawings
Learning Objective:	• To know how to interpret and identify drawing, symbols, scales and engineering language on mechanical drawings.
Samples of Behavior:	• To be able to perform interpretation and identification of drawing, symbols, scales and engineering language on mechanical drawings.
Notes:	
• Must be capable of referencing all aspects of the Mechanical drawing to the Legend Sheet of a project for proper interpretation and identification of symbols and language.	

INTERPRET MECHANICAL DRAWINGS

Background: There are various ways by which drawings tell you what is to be done. If all the information necessary for constructing a building or installing the fuel systems in a building were put in words, then the information would be confusing and hard to understand. You have probably heard the old adage "One picture is worth a thousand words." This saying has a great deal of significance; ask anyone who must use drawings in his or her work. Since written words take up too much space; different means must be used to tell the complete story in drawing form. As a Liquid Fuel Systems Maintenance specialist, the ability to read and interpret drawings is important to you. Drawings serve two purposes. First, in the case of new construction, they show you how a structure is to be built and how equipment and utility systems in that structure are to be installed. Secondly, drawings serve as a guide in maintaining and troubleshooting equipment and systems. The draftsman uses such standard devices as lines, symbols, abbreviations, notes, and various methods of showing dimensions and working directions. You once learned the symbols of math, now you will learn the draftsman's symbols. A draftsman uses very few words, because a large amount of information must be placed in a small area. Learn to recognize the standard drawing symbols and their meanings. Then, with a little practice, you can read and understand drawings as easily as you read your favorite magazine. Now let us take a look at different types of prints, symbols and lines.

- **Blueprints.** The simplest and most used process for making prints that you will use. This is a print with a blue background and white lines.

- **Black and White Prints and Director Prints.** These prints have black lines on a white background and are made directly from the original tracing. They are used extensively when someone wants positive prints.

- **Ozalid Prints.** This process is based on the chemical action of light-sensitive diazo compounds. They are standard papers that give black, blue, or maroon lines on a white background. Since this process can use transparent papers, cloth, and foils for the original drawing, erasures and additions can be made on the original tracing without altering it.

- **Photostat Prints.** These prints are used extensively by large corporations. In this process the drawings are made on dark background with white lines. The drawings can then be photographed and the photographs reduced or enlarged to almost any size.

Details and Views of prints

- **Elevations.** Elevations are front, rear, and side external views of a structure. An elevation is a picture-like view of a building that shows the exterior materials of the foundation, walls, and roof; it also shows the location of windows and doors, and it may show the ground level surrounding the building. When more than one elevation view is shown, each view is identified by a title, such as north elevation or south elevation.

- **Plan view.** Plan views, or architectural blueprints, show a top view. There are several types of plan views, such as site plan, foundation plan, and floor plan. They show you the view of a building from a point directly above. A floor plan shows you the shape of the building; the arrangement, size, and shape of rooms; the thickness of walls and partitions; and the type, size, and the location of doors and windows.

- **Sectional view.** A sectional view is one in which part of the building or structure is cut away to show the concealed features. Sectional views are commonly called cross-sections because they show an object as if it were cut in half, or across. Sectional views let you look inside an object.

- **Print or isometric view.** A print or isometric view is a guide for the fuel systems maintenance specialist. It is the copy of the drawings, which includes dimensions of the structure or equipment. It will have most of the information you need to perform maintenance. A print usually has three views: top, front, and side or end views. These views are made up of lines and symbols that you can see when the structure is viewed from these positions, as shown in Figure 1. The front detail (A) shows how an object would look to an observer who views it from the front; the side detail (B) shows how the object looks from the side; and the top detail (C) shows how it would look from the top.

- **Orthographic view.** An orthographic view consists of three separate views with the front and side elevations, and the top plan view, or architectural drawing.

- **Detail view.** Detail views are large-scale drawings that show how the parts of a building or structure are placed and connected. They are closely related to sectional views. In fact, sections are often used as parts of detail drawings.

Title Block

- **Title Block:** When you refer to a drawing, the first thing to look for is the title block. It has the drawing "headlines," and it is usually in the lower right corner. The title block has the drawing number and all the information you need to identify the building or structure. When drawings are made by the military, the title block has the name and address of the agency that made them; in this case, the name and address of the agency are in the title block. In most cases, the title block has the names of the designer, the draftsman, and the approving official. Information found in the title block is especially important when you may have questions concerning the drawing.

Line and drawing symbols.

- **Line Symbol:** The most basic symbols, and the ones that need the greatest understanding are lines. To use a blueprint or drawing properly, you must understand what line thickness means in various configurations. The American National Standards Institute (ANSI) has established standards for the width of lines used on drawings. On drawings, the heavier lines will be used for the border, the medium lines will be used for the object, and the fine lines will be used for centerlines and dimension lines. Use Figure 2 as you read the following line symbol descriptions.

- **Borderline.** The borderline is the heavy line around the outer edge of the print. It tells the reader that the illustration is complete within these borders. Exactly what the illustration is supposed to be is shown on the legend in the lower right corner along with other reference information.

- **Object Line (Visible Line).** The object or visible line outlines the specific item drawn by the draftsman. It is a medium weight line, which shows the shape of the object to the reader. It is used to outline buildings, partitions within the structure, piping, conduit, etc. It is the most important line on the print because it forms the object to which we are referring.

- **Extension and Dimension Lines.** Extension lines bring meaning to dimension lines. The centerlines and extension lines serve as stops for dimension lines. The extension lines do not touch the object, but start about 1/16 of an inch from the object line and extend about 1/8 of an inch beyond the dimension arrow. In instances where the dimension must be inside the object, the object lines serve as stops.

- **Centerline.** The centerline is used when the reader needs to use the center of an object as reference. Whenever it is used, it adds great significance to the drawing.

- **Cutting Plane.** This is merely a line symbol to give accuracy to the reader as to the view taken by the draftsman.

- **Break Lines.** A detail of piping, shafting, etc., is usually drawn with these lines.

- **Section Lining.** Use this on detail drawings to show material to be used, or to show a cutaway of an object.

- **Hidden Lines.** Hidden lines are medium lines of short dashes, evenly spaced that show hidden features of the object.

Now go to Figure 2 and find examples of each line referred to. Study the drawing carefully, leaving no line unexplained. Also, study commonly used symbols in Figure 3.

Now that you have familiarized your self with prints lets turn our attention to the types of scales that draftsmen use in developing prints. Drafting people draw objects full size when the details of the object are clearly shown and the size of the paper will conveniently permit. They draw enlarged views of sections when the object is so small that full-sized representations would not clearly show the features of the object. They make reduced-scale prints of large objects that can be shown clearly in a smaller scale. The prime reason for reducing the scale of drawings is to reduce their size, so that they can be placed on smaller sheets without crowding the views. The scales of prints are generally noted in the title block as "full size," "enlarged view," or a specific reduced scale, such as 1" = 10', ¼" = 1', etc. The process of measuring dimensions on a print is called scaling. Important dimensions are normally shown on the print and should not be scaled because of the possible distortion of the print on cloth or paper. Several common scales are shown below.

Architect's Scale:

- Architect's scales are divided into proportional feet and inches. They are generally used in scaling prints for machine and structural work. The triangular architect's scale, shown in Figure 4, usually has 11 scales; each subdivided differently. Six of the scales are read from the right end.

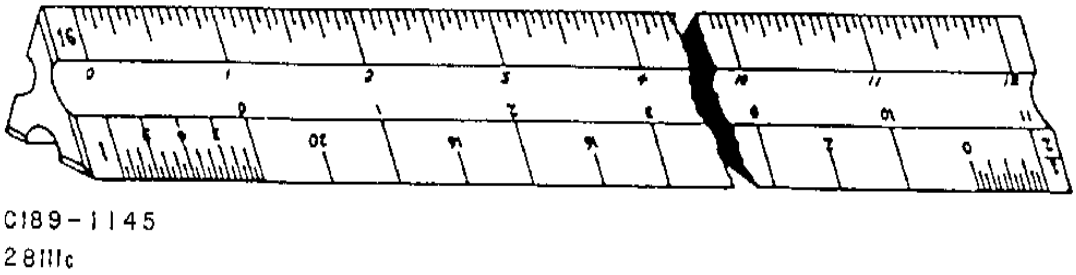


Figure 4, Architect's Scale

Engineer's scale:

- Engineer's scales (Figure 5) are divided into decimal graduations (10, 20, 30, 40, 50, and 60 divisions to an inch). These scales are used for plotting, map drawing, and the graphic solution of problems.

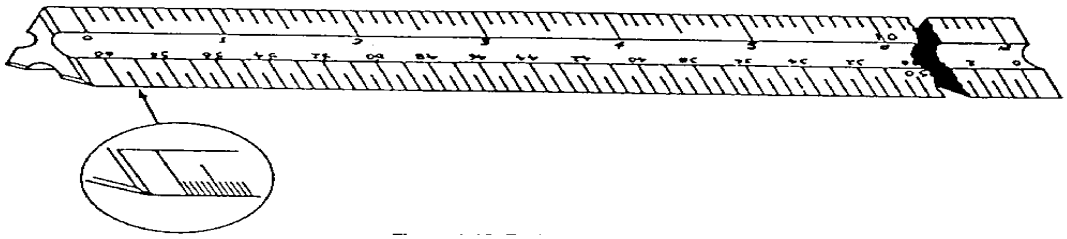


Figure 5, Engineer's Scale

- **Metric Scale.** Metric scales are used in conjunction with drawings, maps, and the like, made in countries using the metric system. The metric system is also being used with increasing frequency in the United States. The scale is divided into millimeters and centimeters.

- **Graphic Scale.** Graphic scales (Figure 6) are lines divided into distances corresponding to convenient units of length of the object shown by the print. They are placed in or near the title block of the print; increasing or decreasing the print size will change the scale lengths accordingly.

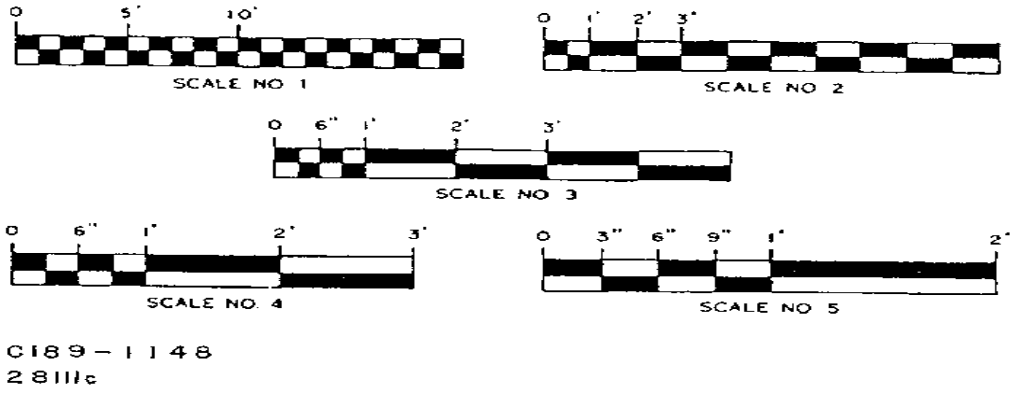


Figure 6, Graphic Scale

Methods of Scaling:

- When you are using the architect's or engineer's scale, you must find the scale of the print from the notations (1" = 10', ¼" = 1', 1" = 20', and the like), then choose the corresponding scale on the architect's or engineer's scale. Using the proper scale, you simply measure the dimensions on the print. For example, if the scale of the print is 1" = 100', then a dimension of 20 divisions on the engineer's scale (10 divisions per inch) represents 200 feet. When you use graphic scales, you usually mark off the length of the dimension you want onto a slip of paper, place the slip of paper on the graphic scale, and read the distance.

- In addition to the drawings in a set of prints, you will work with drawings called *diagrams*. To be a good troubleshooter, you must be able to read and interpret diagrams. Remember that the principle characteristics of these diagrams apply to all utilities systems. The schematic diagram is a drawing that shows the fuel system plan of operation for a piece of equipment, or part. The position of parts is not shown in this type of diagram. The schematic diagram, like the connection diagram, makes use of symbols instead of pictures. The schematic shown in Figure 7 below is a plan of the fuel system layout. It is laid out so that the components are in line to make it easy to trace the operation. The schematic is sometimes called an elementary or one-line diagram, and it is very useful in troubleshooting or tracing the plan of operation.

SAFETY:
ALWAYS ENSURE YOU ARE REVIEWING THE MOST CURRENT UPDATED COPY OF DRAWINGS WHEN EXTRACTING TECHNICAL INFORMATION FOR MAINTENANCE PURPOSES.

NOTE:
When alterations or modifications are made to the fuel system, ensure all changes are inserted into the drawing with the assistance of the BCE Engineering Flight for future reference.

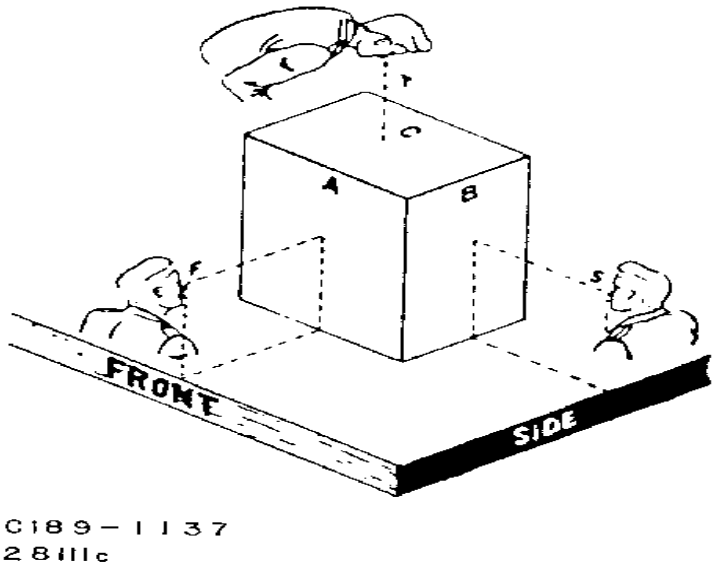


Figure 1, Print or Isometric view

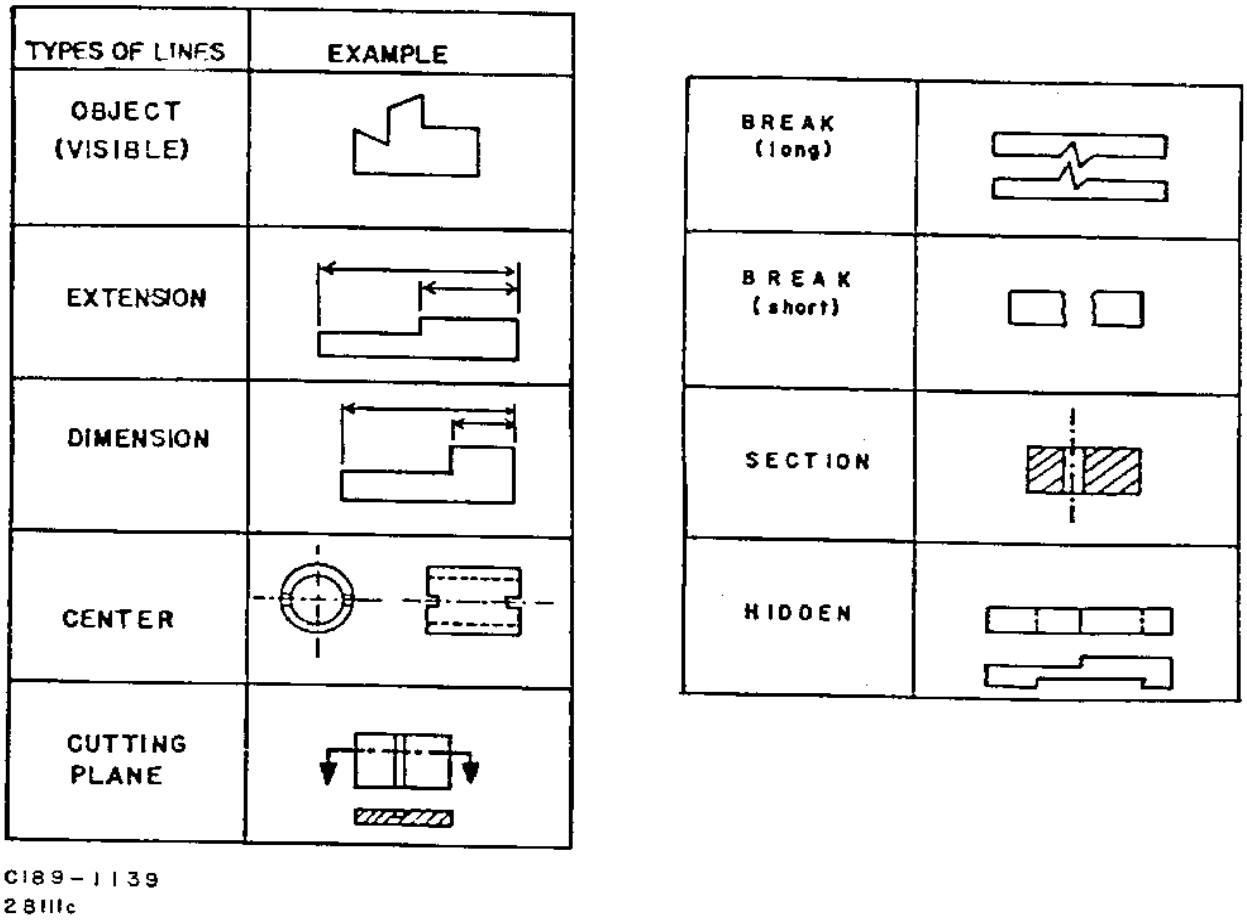
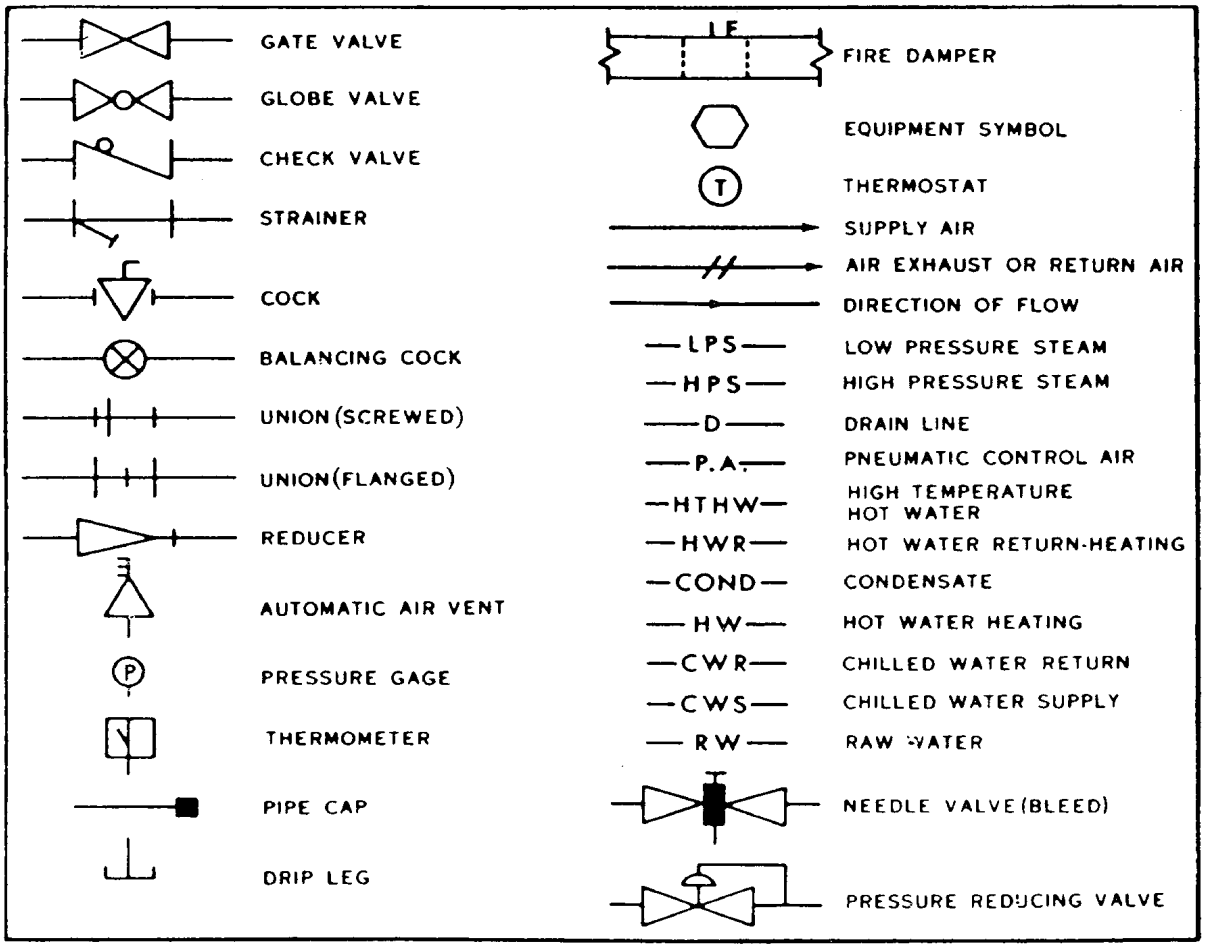


Figure 2, Types of Lines



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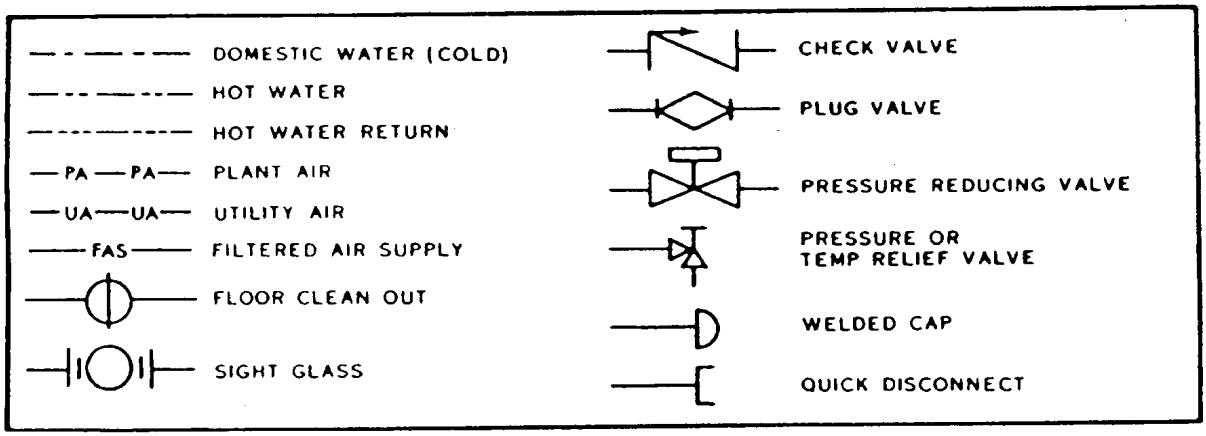

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Figure 3, Symbols

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To perform this task, follow these steps:

Step 1: Identify types of prints.
Describe the type of print of the mechanical project drawing to the trainer

Step 2: Recognize various views and details of prints.
Locate on the print the following views and details; Elevations, plan view, print view, and detail view.

Step 3: Review the title block.
Describe to trainer what information is in the title block

Step 4: Interpret line and drawing symbols.
Locate on the print the following lines; Object line, dimension line, symbols and centerline. Use the information and compare it to the main legend.

Step 5: Use scales to calculate print dimensions.
Describe what units are on the Architect's/Engineers scale to the trainer. Find a graphics scale on the print. Use this information to scale a section of line determined by the trainer.

Step 6: Map system operations from schematic diagrams.
Using Figure 7 in this QTP describe to trainer the operation of the fuel system. Locate a schematic diagram on the print and due the same

Scales:

-

Diagrams:

Schematic Diagram:

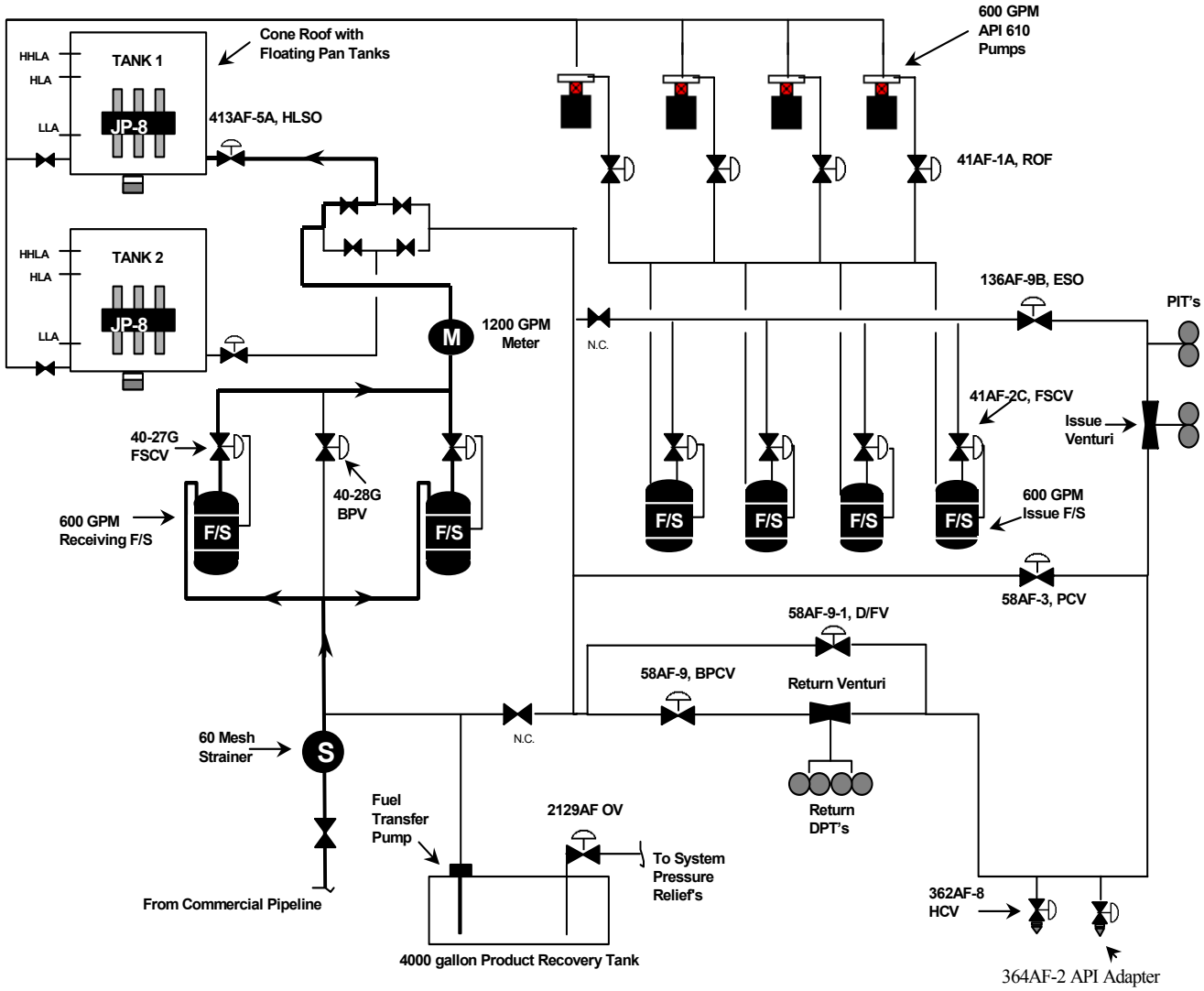


Figure 7, Type III System

Review Questions
for
Interpret Mechanical Drawing

Question	Answer
1. What is the simplest and most often used print?	a. Black & White b. Blue c. Ozalid d. Photostat
2. Which view looks as if it was cut in half?	a. Elevation b. Plan c. Sectional d. Isometric
3. These are the most basic symbols for lines.	a. Center b. Border c. Object d. Lines
4. They are medium lines of short dashes, evenly spaced.	a. Cutting plane b. Break c. Hidden d. Extension & Dimension
5. This scale is divided into decimal graduations of (10, 20, 30 etc. divisions of a inch).	a. Engineers b. Architect c. Metric
6. If you enlarge your print, you can still use your Graphic Scale.	a. True b. False
7. The drawing number is located in the Title Block.	a. True b. False
8. Diagrams apply to fuel system utilities only.	a. True b. False
9. A Schematic diagram is useful in troubleshooting and tracing the plan of operation.	a. True b. False

INTERPRET MECHANICAL DRAWING

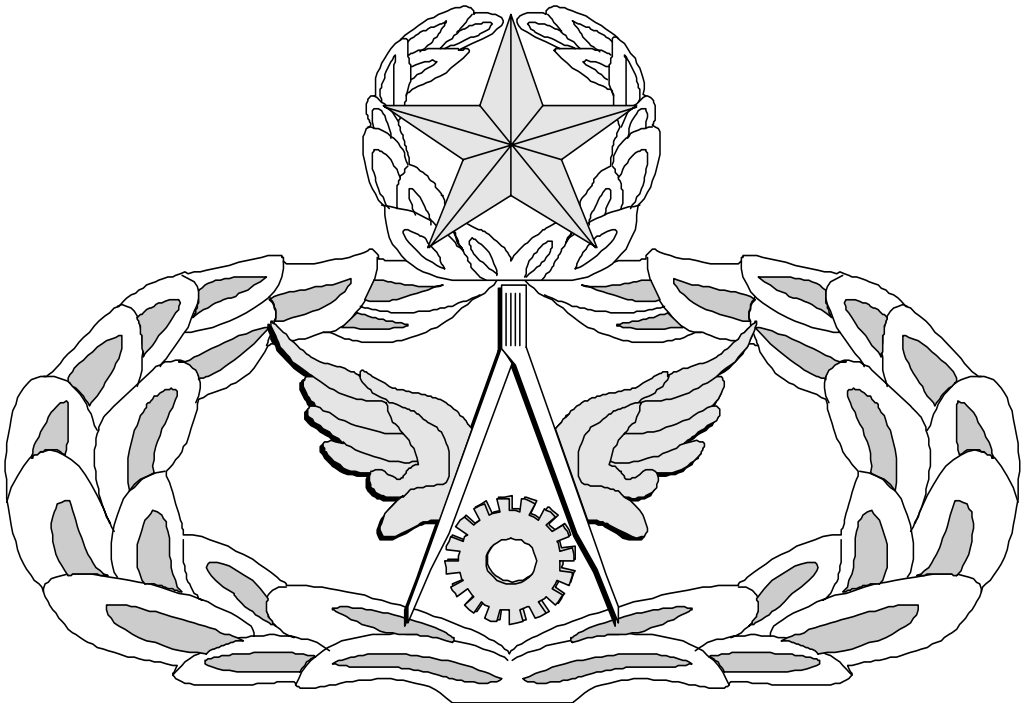
Performance Checklist		
Step	**Yes**	**No**
1. Can the trainee identify the various types of prints?		
2. Can the trainee Identify different views and details of the folowing drawings: a. Elevations b. Plan views c. Print view d. Detail view		
2. Can the trainee explain the significance of the information in the TitleBlock?		
3. Can the trainee relate drawing symbols to the main legend directory?		
4. Can the trainee use scales to calculate distances from the prints? a. Did trainee understand the different unit of the Architect/Engineers scale? b. Did trainee calculate the correct distances?		
5. Can the trainee follow the schematic through the operational sequence of the drawing?		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For

LIQUID FUEL SYSTEMS MAINTENANCE

(3E4X2)

MODULE 14

FUEL SYSTEMS

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INTREPRET MECHANICAL DRAWING

(3E4X2-14.2)

Question	Answer
1. What is the simplest and most often used print?	b. Blue
2. Which view looks as if it was cut in half?	c. Sectional
3. These are the most basic symbols for lines.	d. Lines
4. They are medium lines of short dashes, evenly spaced.	c. Hidden
5. This scale is divided into decimal graduations of (10, 20, 30 etc. divisions of a inch).	a. Engineers
6. If you enlarge your print, you can still use the Graphic Scale.	a. True
7. The drawing number is located in the Title Block.	a. True
8. Diagrams apply to fuel system utilities only.	b. False
9. A Schematic diagram is useful in troubleshooting and tracing the plan of operation.	a. True